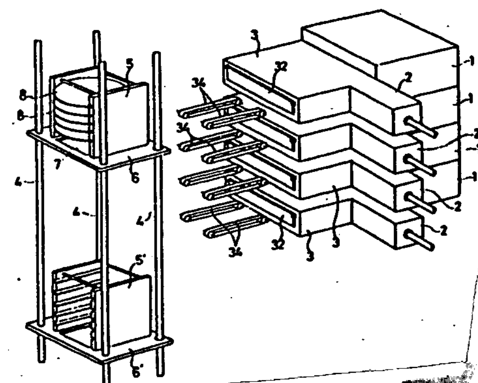
(54) MULTISTAGE PLASMA PROCESSOR
(11) 60-10625 (A) (43) 19.1.1985 (19) JP
(21) Appl. No. 58-118017 (22) 29.6.1983
(71) TOUKIYOU DENSHI KAGAKU K.K. (72) AKIRA UEHARA(2)
(51) Int. Cl⁴. H01L21/302

PURPOSE: To continuously process via various types of plasmas by arranging to elevationally superpose plasma generating chambers attached with vacuum preliminary chambers and elevationally movably holding a cassette which contains wafers at the side of the chambers.

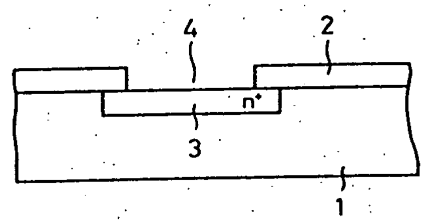
CONSTITUTION: Vacuum preliminary chambers 3 are individually attached through intermediate chambers 2 at the side of plasma generating chambers 1. Guide rods 4 are stood at the side of the chambers 3, thereby elevationally movably holding a cassette base for placing wafer containing cassettes 5. A pair of parallel belt conveyors are arranged in the chambers 3. Belt conveyors 34 are arranged at the side, and introduced into notches 7 formed at the base 5 supported by a guide member 4 by moving the conveyor 34.



(54) MANUFACTURE OF SEMICONDUCTOR DEVICE
(11) 60-10626 (A) (43) 19.1.1985 (19) JP
(21) Appl. No. 58-119611 (22) 29.6.1983
(71) MITSUBISHI DENKI K.K. (72) HIROSHIGE TAKAHASHI(5)
(51) Int. Cl⁴. H01L21/302

PURPOSE: To accurately etch by simultaneously forming a monitoring pattern for measuring the etching amount larger than a contacting hole at the place except the place where a semiconductor element is formed at the time of forming the hole.

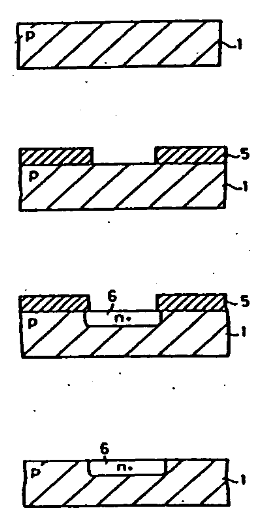
CONSTITUTION: An interlayer insulating film 2 is formed on a silicon substrate 1, and patterned. An n^+ type diffused layer 3 is formed on the substrate 1. A monitoring pattern 4 for measuring the etching amount of $5\mu m \times 5\mu m$ is formed on the place except a semiconductor element. The pattern 4 is formed simultaneously with the formation of a contacting hole. Since the etching amount is monitored by the pattern 4, the hole can be extremely accurately etched.



(54) MANUFACTURE OF SEMICONDUCTOR DEVICE
(11) 60-10627 (A) (43) 19.1.1985 (19) JP
(21) Appl. No. 58-116955 (22) 30.6.1983
(71) FUJITSU K.K. (72) TADASHI KIRISAKO
(51) Int. Cl⁴. H01L21/302,H01L21/02

PURPOSE: To simply form an accurate alignment mark without decreasing the characteristics by previously forming the mark when an original crystal is numbered, an utilizing the mark subsequently for the step of opening.

CONSTITUTION: An original si crystal 1 is numbered by a laser. After numbering, a desired alignment mark is formed by the same laser. Then, a resist 5 is coated on the crystal 1, and a window is formed at the resist by etching. Then, an n type impurity material ions are implanted on the opened region to form a desired buried region 6. Then, the remaining resist 5 is removed.



⑲ 日本国特許庁（JP）　⑪特許出願公開
⑫ 公開特許公報（A）　昭60−10625
㉛Int. Cl.⁴ 　識別記号　庁内整理番号　㊸公開　昭和60年（1985）1月19日
H 01 L 21/302　　B 8223−5F
発明の数　1
審査請求　未請求
（全　6　頁）

㉔多段プラズマ処理装置

㉑特　願　昭58−118017
㉒出　願　昭58（1983）6月29日
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明　細　書

1.　発明の名称

多段プラズマ処理装置

2.　特許請求の範囲

(1)　上下方向に重なるように配設されるとともに内部にウエハー搬送装置を組込んだ複数のプラズマ発生用チャンバーと、これら各プラズマ発生用チャンバーの側部に付設されるとともに内部ウエハー搬送装置を組込んだ真空予備室と、これら真空予備室の側方に立設されたガイド部材と、このガイド部材に昇降動可能に支持されるウエハー収納用カセットと、このウエハー収納用カセットと前記プラズマ発生用チャンバーとの間でウエハーを出し入れするための搬送装置とを備えてなる多段プラズマ処理装置。

(2)　前記真空予備室はプラズマ発生用チャンバーの一側部に付設されたことを特徴とする特許請求の範囲第1項記載の多段プラズマ処理装置。

(3)　前記真空予備室はプラズマ発生用チャンバーを挟んで両側部に付設されたことを特徴とする特許請求の範囲第1項記載の多段プラズマ処理装置。

3.　発明の詳細な説明

本発明はLSI或いは超LSI等の大規模集積回路を形成したチップ素材となる半導体ウエハーにプラズマ処理を施す装置に関する。

LSI、超LSI等の大規模集積回路を形成したチップを製造するには、半導体ウエハーに微細パターンを形成したレジスト膜を介して、絶縁膜、半導体膜或いは金属膜をエッチングする工程、上記膜をクリーニングする工程及びエッチングに使用したレジスト膜をウエハー表面から除去する~~デ~~ ~~ーーーー~~工程を必要としている。

そして、上記各工程を行うには無機酸、有機溶剤等の種々の液体化学薬品を用いた湿式処理と、プラズマを用いた乾式処理があるが、最近では加工精度及び作業性に優れたプラズマ処理を行う傾向にある。

しかしながら、上記各工程をプラズマ処理によつて行うとしても、各工程における処理条件、例

えば真空度、処理時間及び反応ガス等は各工程毎に異なり、また従来のプラズマ処理装置は1つのプラズマ発生用チャンバー（処理室）しか備えていないため、1つの処理装置で複数の工程を連続的に行うことができない。

斯る問題は1つのプラズマ処理装置に複数のプラズマ発生用チャンバーを設ければよいのであるが、単に複数のプラズマ発生用チャンバーを設けただけでは装置自体極めて大型化し、更にウエハーをチャンバーへ移す機構も複雑となり、かえつて処理が面倒となる。

本発明は上述した従来の問題点を改善すべく成したものであり、その目的とする処は、従来のプラズマ処理装置と比べて略々同じ大きさで済み、しかもウエハーを異なる条件で連続的に処理し得る多段プラズマ処理装置を提供するにある。

この目的を達成すべく本発明に係る多段プラズマ処理装置は、一側部或いは両側部に真空予備室を付設した複数のプラズマ発生用チャンバーを装置内に上下方向に重ねて配設し、また前記真空予

備室の側方にガイド部材を設け、このガイド部材にウエハー収納カセットを昇降自在に保持せしめ、ガイド部材を設けた側の真空予備室の側方、真空予備室内部及びプラズマ発生用チャンバー内部のそれぞれに配設された搬送装置により、ウエハー収納カセットとプラズマ発生用チャンバー内との間でウエハーを出し入れするようにしたことをその要旨とする。

以下に本発明の実施例を添付図面に基づいて説明する。

第1図は本発明に係る多段プラズマ処理装置の要部の斜視図であり、上下方向に複数段重なる如く配設されたプラズマ発生用チャンバー1…の一側部には、中間室2…を介して真空予備室3…が個別に付設されている。また、真空予備室3の側方には一対の平行なガイドロッド4，4が立設され、これらガイドロッド4，4によりウエハー収納用カセット5を載置するカセット台6の昇降動が案内され、それについて該カセット5が昇降動する。この収納用カセット台6の昇降動は例えば

パルス制御されるモータによつて回転するネジロッドにカセット台6の一部を螺合せしめるようにして行う。

ウエハー収納用カセット台6は中央に切欠7を形成した平面コ字状をなし、ウエハー収納用カセット5を載置したときに、ウエハー8を出し入れ自在としている。

一方、前記プラズマ発生用チャンバー1、中間室2及び真空予備室3の内部構造は第2図及び第3図に示すように、プラズマ発生用チャンバー1の上壁9には反応ガスの導入管10を、側壁11には真空ポンプにつながる真空引き用のパイプ12を取り付け、またチャンバー1内には高周波電源につながる上部電極13と下部電極14とからなる平行平板型電極を設け、この下部電極14内に冷却水導入管15及び排水管16を介して冷却水を循環せしめるようにしている。また下部電極14の中央からはウエハー載置台17が昇降動自在に突出しており、この載置台17はその下降限において下部電極と略々面一となるようにされている。

そしてチャンバー1内の下部で下部電極14よりも若干上方には一対の平行なベルトコンベア18，18が左右方向に移動可能に配設されている。

また、チャンバー1と開口19を介して連通し、真空予備室3と開口20を介して連通する中間室2内には弁装置21が設けられている。この弁装置21はシリンダ22のロッド23に固着された支持部24と、この支持部27にリンク25，25を介して連結し、前面にシール26を取付けた弁体27とからなり、ロッド23がシリンダ22内に引つ込んでいるときには第4図(イ)に示す如く、スプリングによつて弁体27先端部が支持部24の先端部よりも突出し、シリンダ22を作動させて、ロッド23を突出せしめ第4図(ロ)に示す如く弁体27の先端部を中間室2の側壁に当接させ、更にロッド23を突出させることで弁体27を前方へ移動せしめて、前記開口19を閉じ、チャンバー1と真空予備室3とを気密に隔離する。

また、真空予備室3の上壁28には真空引き用のパイプ29を取付け、側壁30には開口31を

開閉する弁体32を設け、更に真空予備室3内には一対の平行なベルトコンベア33，33を配設している。そして、開口31の側方にも一対の平行なベルトコンベア34，34が配設され、このベルトコンベア34は前後方向（第2図、第3図において左右方向）に全体的に移動可能とされ、前方（第2図、第3図中左方）に移動することで、前記ガイド部材4，4に支持されたカセット台6に形成した切欠7内に入り込むようにされ、後方に移動することで、その後端部が開口31の近傍に位置するようにしている。そして、このベルトコンベア34，34も各プラズマ発生用チャンバー1に対応して個別に設けられ、且つベルトコンベア34及び前記ベルトコンベア18，33のベルト面は同一平面上にあるようにしている。

尚、ベルトコンベア34は図示例にあつては、各プラズマ発生用チャンバー1毎に対応して個別に配設したが、ベルトコンベア34を昇降動自在とすれば、1つのベルトコンベア34により共用を図ることも可能である。

次に以上の如き構成からなるプラズマ処理装置の使用例を述べる。尚、この場合最上段に位置する第1段目のチャンバーと、第2段目のチャンバーにおいては CCl_4 ガスを導入してウエハー上のアルミニウム膜の選択的なエッチングを行い、第3段目のチャンバーでは CF_4 ガスを導入してウエハーのクリーニングを行い、第4段目のチャンバーにおいてはアルミニウム膜上のホトレジスト層をアッシング除去することを本発明の一例として次に具体的に説明する。

先ず、ガイド部材4，4に支持されたカセット台6上に例えば25枚の未処理のウエハー8…を収納したカセット5を載置し、これを最上段のチャンバー1よりも上方となるように位置せしめ、このカセット5よりも下方にカセット台6′上に載置した空のカセット5′を位置せしめる。斯る状態からベルトコンベア34を前方へ移動させ、これと同時にカセット台6を降下させる。すると、カセット台6には切欠7が形成されているのでカセット5の降下により最下段のウエハー8がベルト

コンベア34上に載る。そこで、カセット5の降下を停止するとともにベルトコンベア34を後方へ移動する。

次いで、弁体32を回動させて開口31を開き、ベルトコンベア34及び33を駆動せしめることでウエハー8を真空予備室3に入れる。尚、この場合、真空予備室3と中間室2とを連通する開口19は弁装置21によつて閉じられている。

そして、弁体32によつて開口31を閉じた後、真空予備室3を所定の真空度になるまで真空引きし、所定の真空度に到達したならば弁装置21によつて開口19を開き真空予備室3とチャンバー1内とを連通する。そして、ベルトコンベア33及び18を駆動することでウエハー8をチャンバー1内に搬入する。この場合、チャンバー1内は既に所定の真空度に保持されている。

而る後、弁装置21によつて開口19を閉じるとともに反応ガス導入管10を介してチャンバー1内に CCl_4 ガスを導入する。また、これと同時にウエハー載置台17が上昇し、ベルトコンベア18

上にあつたウエハー8をウエハー載置台17上に載せ、この後ベルトコンベア18，18が左右に移動してその間隔がウエハー8の径よりも大きくなる。次いで、ウエハー載置台17が降下してウエハー8を下部電極14上に載置する。この状態から、上部電極13と下部電極14との間に高周波を印加しプラズマを発生せしめ、ウエハー8表面のアルミニウム膜をエッチングする。

そして、第1段目のチャンバー1における処理が半分程度まで済んだならば、前記同様の操作により、カセット5の下から2段目に収納されていたウエハー8を第2段目のチャンバー1内に搬入し、この第2段目のチャンバー1内において CCl_4 ガスを用いてウエハー8表面のアルミニウム膜のエッチングを行う。

尚、このエッチング処理の間に、前記カセット5を一旦上昇させ、カセット5′を最上段のチャンバー1に対応する位置まで上昇させておく。

そして、第1段目のチャンバー1におけるエッチング処理が終了したならば前記とは逆の操作に

よりウエハー8を真空予備室3に戻し、ベルトコンベア33，34を駆動してウエハー8をベルトコンベア34上に載せ、このベルトコンベア34を前方に移動せしめて、アルミニウム膜のエッチング処理が終了したウエハー8を空のカセット5′内に収納する。

次いでベルトコンベア34をカセット5，5′の昇降動と干渉しない位置まで戻す。この後、3段目のプラズマ発生用チャンバー1に対応して設けられたベルトコンベア34を前方に移動せしめるとともに空のカセット5′を降下せしめ、3段目のベルトコンベア34上にアルミニウム膜のエッチング処理が終了したウエハー34を載置する。そして、前記同様の操作でこのウエハーを3段目のプラズマ発生用チャンバー1内に搬入する。ここで3段目のプラズマ発生チャンバー1内には反応ガスとしてCF_4ガスを充填し、このチャンバー1内ではプラズマクリーニング処理を行う。

一方、アルミ膜のエッチング処理が終了したウエハー8に対し3段目のチャンバー1でクリーニング処理を行つている間に、最上段のチャンバー1内では、カセット5の最下段から3段目に収納されていたウエハー8のアルミニウム膜エッチング処理を施すこととなる。

そして、3段目のチャンバー1内でクリーニング処理が施されたウエハー8は前記同様の操作で再び空のカセット5′内に戻され、次いで前記同様の操作により今度は4段目のチャンバー1内に搬入される。そしてこのチャンバー1内には反応ガスとしてO_2ガスを導入し、プラズマによりレジスト膜のアッシング処理を行う。これと併行して第2段目のチャンバー1内でアルミニウム膜のエッチング処理が終了したウエハー8を3段目のチャンバー1内にてクリーニング処理を施す。

このようにして、複数枚のウエハーに対し、異なる処理条件下において、連続的にプラズマ処理を施す。

尚、以上の使用例は一例に過ぎず、反応条件等は任意に設定できるものであり、また実施例にあつては個々のプラズマ発生用チャンバー毎に真空ポンプ及び高周波電源を設けるようにしたが、1つの真空ポンプ或いは高周波電源を共用するようにしてもよい。

また、図示例にあつてはプラズマ発生用チャンバー1…の一側部に真空予備室3…を付設したものを示したが、プラズマ発生用チャンバー1…の両側部に真空予備室3を付設し、一方の真空予備室3から搬入したウエハー8を他方の真空予備室3を介して搬出するようにしてもよい。尚、この場合はそれぞれの真空予備室の側方にガイド部材4を立設する必要がある。

以上に説明したように本発明によれば、装置内に真空予備室を付設したプラズマ発生用チャンバーを上下方向に重なる如く配設し、真空予備室の側方にはガイド部材を介してウエハーを収納したカセットを昇降動自在に保持し、更に搬送装置により、上記チャンバーとカセットとの間でウエハーを出し入れ可能としたので、1つの装置で複数のウエハーに対し、異なる条件下において連続的に各種プラズマ処理を行うことができ、従来に比べ飛躍的に生産効率が向上するとともに、装置自体が占めるスペースも従来装置と然程変わることがない等多くの効果を発揮する。

4. 図面の簡単な説明

第1図は本発明に係る多段プラズマ処理装置の要部を示す斜視図、第2図は同要部の縦断面図、第3図は同要部の横断面図、第4図(イ)，(ロ)は弁装置の作動を示す横断面図である。

尚、図面中1はプラズマ発生用チャンバー、3は真空予備室、4はガイド部材5，5′はウエハー収納用カセット、8はウエハー、13，14は電極、18，33，34は搬送装置、21は弁装置である。

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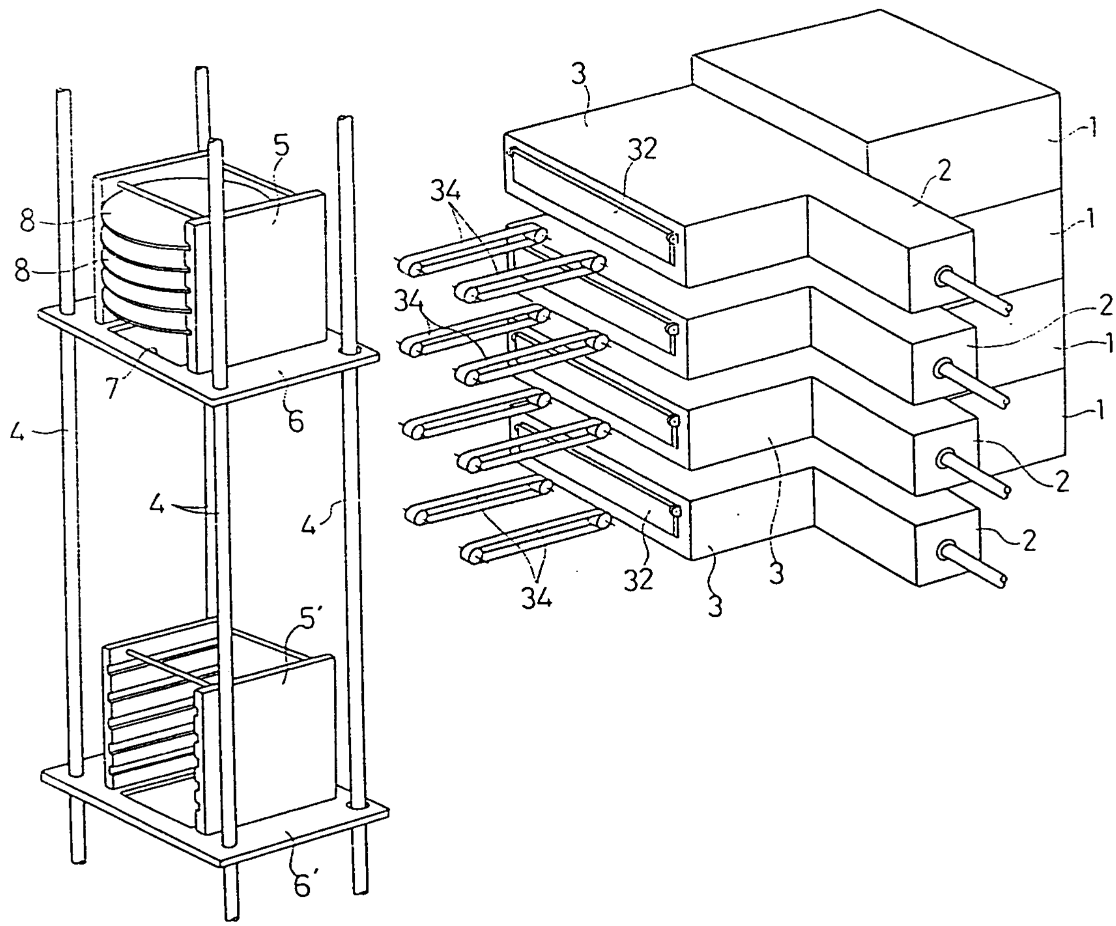
代理人　弁理士　下田容一郎
同　弁理士　大橋邦彦
同　弁理士　小山有

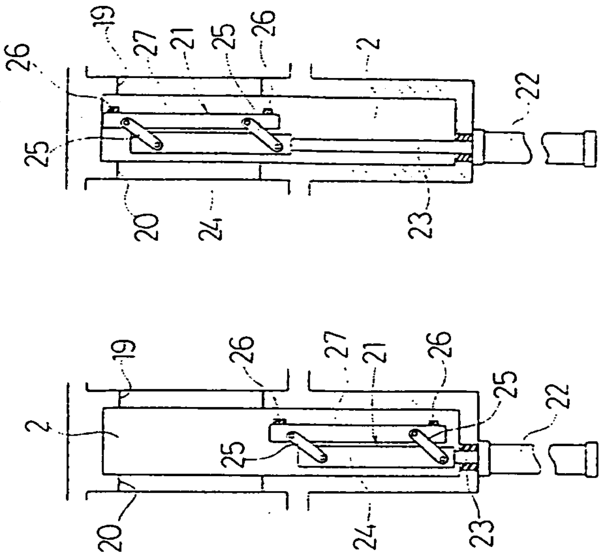
第 1 図



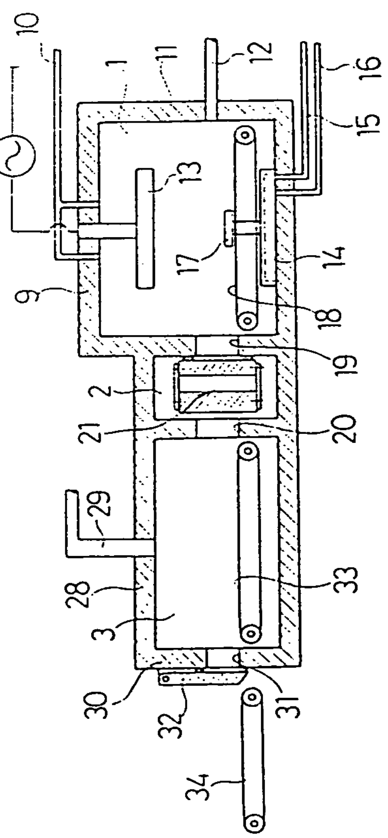
第4図

(イ)

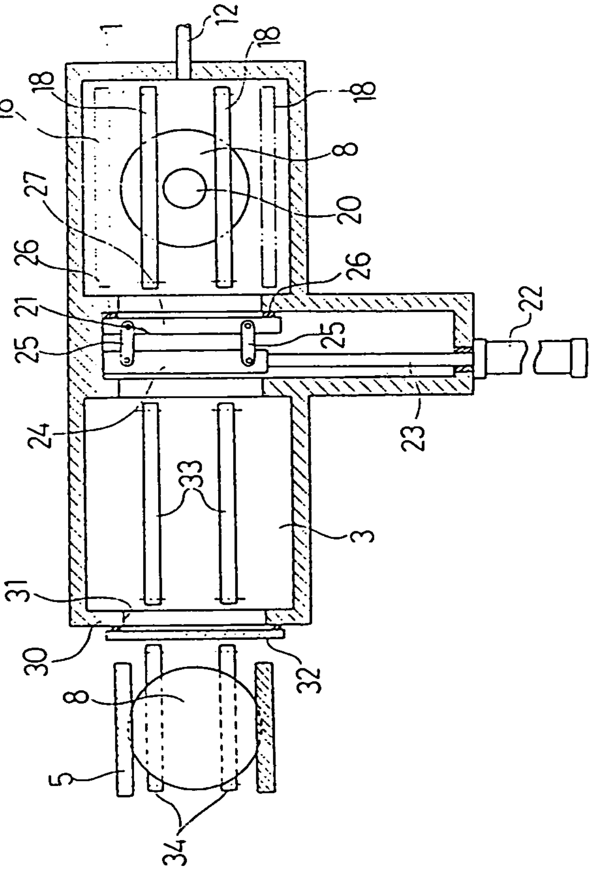
(ロ)



第2図



第3図



PTO 99-4313

Japan
60-10625

MULTI-STEP PLASMA TREATMENT DEVICE
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UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D. C. July 1999

Translated by: Schreiber Translations, Inc.

Country	:	Japan
Document No.	:	60-10625
Document Type	:	Patent Publication
Language	:	Japanese
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IPC	:	H 01 L 21/302
Application Date	:	June 29, 1983
Publication Date	:	January 19, 1985
Foreign Language Title	:	Tadan Purazuma Shori Sochi
English Title	:	MULTI-STEP PLASMA TREATMENT DEVICE

Specification /1[1]

1. Title of the Invention: MULTI-STEP PLASMA TREATMENT DEVICE

2. Claims

1. A multi-step plasma treatment device which possesses multiple plasma generation chambers which are configured in overlapping fashions along the vertical direction and into the interiors of which have been integrated wafer transportation mechanisms, vacuum preliminary chambers which are attached to the profile portions of said respective plasma generation chambers and into the interiors of which have been integrated wafer transportation mechanisms, guide components which are erected on both sides of these vacuum preliminary chambers, wafer storage cassettes which are supported by said guide components in (un)liftable fashions, and a transportation mechanism which enables the exchange of wafers between said wafer storage cassette and said plasma generation chambers.

2. The multi-step plasma treatment device specified in Claim 1 wherein said vacuum preliminary chamber is configured on one profile side of the plasma generation chamber.

3. The multi-step plasma treatment device specified in Claim

[1]Numbers in the margin indicate pagination in the foreign text.

1 wherein said vacuum preliminary chamber is auxiliarily configured on both profile segments of adjacent plasma generation chambers.

3. Detailed explanation of the invention

The present invention concerns a device which is used for the plasma treatment of a semiconductor wafer which serves as a chip material for large-scale circuits such as LSIs, super-LSIs, etc.

In order to manufacture a chip on which a large-scale circuit such as LSI, super-LSI, etc. has been formed, a process for etching an insulating film, semiconductor film, or a metal film via a resist film which confers a microscopic pattern on a semiconductor wafer, a process for cleaning the aforementioned film, and a process for removing the resist film which has been used for the etching operation from the wafer surface are necessary.

The aforementioned respective processes may be implemented based on the wet treatment format, in which various liquid chemicals (e.g., inorganic acids, organic solvents, etc.) are used, or on the dry treatment format, in which a plasma is used, and the plasma treatment, which is superior in terms of processing precision and operative efficiency, has recently become popular.

Even if the aforementioned processes are implemented based on the plasma treatment format, however, the treatment conditions of the respective processes (e.g., vacuum magnitude, reaction time,

reaction gas, etc.) differ from one another, and since only one plasma generation chamber (treatment chamber) is configured in the plasma treatment device of the prior art, the continuation of multiple processes by using a singular treatment device is infeasible. /2

It may seem as if this problem were solvable by configuring multiple plasma generation chambers within a singular plasma treatment device, but in a case where multiple plasma generation chambers are simply configured, an extreme enlargement of the device becomes unavoidable, and a more complicated mechanism for transferring wafers into chambers becomes necessary, as a result of which the treatments become more cumbersome.

The objective of the present invention, which has been conceived for alleviating the aforementioned problems of the prior art, is to provide a multi-step plasma treatment device the size of which is virtually identical to that of a plasma treatment device of the prior art and which enables continuous treatments of wafers under different conditions.

In order to achieve this objective, the multi-step plasma treatment device of the present invention is characterized by a constitution wherein multiple plasma generation chambers to either or both profile portions of which are auxiliarily attached vacuum

preliminary chambers are configured in overlapping fashions along the vertical direction, whereas guide components are erected on both sides of these vacuum preliminary chambers in such a way that wafer storage cassettes can be supported by said guide components in (un)liftable fashions, whereas the wafer exchange between the wafer storage cassette and the interior of the plasma generation chamber is enabled by a transportation mechanism which has been configured not only on each of the profile sides of the vacuum preliminary chambers on the side where the guide components are configured but also in the interior of the vacuum preliminary chambers and in the interior of the plasma generation chambers.

In the following, an application example of the present invention will be explained with reference to an attached figure.

Figure 1 is a diagram which shows an oblique view of the main components of the multi-step plasma treatment device of the present invention. The vacuum preliminary chambers (3), ... are individually and auxiliarily configured on either profile sides of the multiple plasma generation chambers (1), ..., which have been configured in overlapping fashions along the vertical direction, via the intermediate chambers (2), ... A pair of parallel guide rods (4) and (4) are erected on [both] profile sides of each vacuum preliminary chamber (3). The cassette mount (6), on which the

wafer storage cassette (5) is mounted, is guided by said guide rods (4) and (4), and ascending or descending actions of said cassette (5) are concomitantly invoked. The ascending or descending actions of said cassette mount (6) may, for example, be obtained by partially screwing the cassette mount (6) into a screw rod which is rotated by a pulse-controlled motor.

A コ-shaped planewise shape on which the notch (7) has been formed at its center is embodied by the cassette mount (6), and the exchange of the wafer (8) is enabled while the wafer storage cassette (5) is being mounted on it.

As far as the internal structures of the aforementioned plasma generation chamber (1), intermediate chamber (2), and the vacuum preliminary chamber (3) are concerned, the reaction gas inlet tube (10) is attached to the upper wall (9) of the plasma generation chamber (1), whereas the vacuum suction pipe (12), which is connected to a vacuum pump, is attached to its side wall (11), whereas a parallel flat sheet-type electrode structure constituted by the upper electrode (13) and the lower electrode (14), which are connected to a high-frequency power source, is configured within the plasma generation chamber (1), whereas cooling water is circulated through the interior of said lower electrode (14) via the cooling water inlet tube (15) and the water drainage tube (16),

as Figures 2 and 3 indicate. The wafer mount platform (17), furthermore, protrudes from the middle of the lower electrode (14) in (un)liftable fashions, and the descension limit of this mount platform (17) and the lower electrode virtually share a common plane. A pair of parallel belt conveyers (18) and (18), furthermore, are configured slightly above the lower electrode (14) in the lower portion of the interior of the chamber (1) for enabling transportations between the left and right.

The valve mechanism (21), furthermore, is configured within the intermediate chamber (2), which is linked to the chamber (1) via the opening (19) and to the vacuum preliminary chamber (3) via the opening (20). This valve mechanism (21) is constituted by the support unit (24), which is fixed to the rod (23) of the cylinder (22), and the valve mainframe (27), which is linked to said support unit (27) [sic: Presumably "(24)"] via the links (25) and (25), and to the frontal plane of which is attached the seal (26). While the rod (23) remains withdrawn inside the cylinder (22), the front end of the valve mainframe (27) protrudes springwise from the front end of the support unit (24), thereby activating the cylinder (22) and inducing the protrusion of the rod (23), as Figure 4 (a) indicates, whereas the chamber (1) and vacuum preliminary chamber (3) are hermetically insulated from one another as a result of the contact

of the front end of the valve mainframe (27) with the side wall of the intermediate chamber (2), followed by the protrusion of the rod (23), forward displacement of the valve mainframe (27), and the closure of the aforementioned opening (19), as Figure 4 (b) indicates. /3

Moreover, the vacuum suction pipe (29) is attached to the upper wall (28) of the vacuum preliminary chamber (3), whereas the valve mainframe (32), which opens or closes the opening (31), is configured on its side wall (30). A pair of parallel belt conveyers (33) and (33) are configured within the vacuum preliminary chamber (3), whereas another pair of belt conveyers (34) and (34) are configured on the profile ends of the opening (31). Said belt conveyers (34) enable overall movements along forward and backward directions (between left and right in Figures 2 and 3), and in a case where they are moved forward (toward the left in Figures 2 and 3), they are latched into the notch (7), which has been formed on the cassette mount (6), which is being supported by the aforementioned guide rods (4) and (4), whereas in a case where they are moved backward, their rear ends are positioned in the vicinity of the opening (31). These belt conveyers (34) and (34), too, are configured individually in correspondence to the respective plasma generation chambers (1),

whereas the belt planes of the belt conveyers (34) and the aforementioned belt conveyers (18) and (33) are located virtually on an identical plane.

Incidentally, the belt conveyers (34) were configured individually in correspondence to the respective plasma generation chambers (1) in the example shown in the figure, but a single belt conveyer (34) may be shared by them by designing the belt conveyer (34) in (un)liftable fashions.

Next, a utility example of a plasma treatment device characterized by the foregoing constitution will be discussed. In this case, an aluminum film above a wafer is selectively etched in the first-step chamber, which is located at the uppermost position, and the second-step chamber, whereas said wafer is cleaned in the third-step chamber by introducing gaseous CF_4, whereas a photoresist layer above the aluminum film is removed by means of ashing in the fourth-step chamber. Next, it will be concretely explained as an example of the present invention.

First, the wafer storage cassette (5), in which twenty-five yet-to-be-treated wafers (8), ... are being stored, is mounted onto the cassette mount (6), which is being supported by the guide rods (4) and (4), and after it has been positioned above the uppermost chamber (1), the vacant cassette (5'), which is being mounted on

the cassette mount (6'), is positioned underneath said cassette (5). The belt conveyers (34) are moved forward from this state while the cassette mount (6) is being induced to descend concomitantly. Since the notch (7) is formed on the cassette mount (6), the lowermost wafer (8) comes to be mounted on the belt conveyers (34) as a result of the descension of the cassette (5), as a result of which the descension of the cassette (5) is stopped, and the conveyers (34) are moved backward.

Next, the opening (31) is opened by rotating the valve mainframe (32), and the belt conveyers (34) and (33) are driven, as a result of which the wafer (8) is inserted into the vacuum preliminary chamber (3). In this case, the opening (19), which links the vacuum preliminary chamber (3) and intermediate chamber (2), is closed by the valve mechanism (21).

After the opening (31) has been closed by the valve mainframe (32), vacuum suction is performed until a desired magnitude of vacuum is achieved in the vacuum preliminary chamber (3), and after the desired magnitude of vacuum has been achieved, the opening (19) is opened by the valve mechanism (21) for linking the vacuum preliminary chamber (3) and the chamber (1). The wafer (8), furthermore, is imported into the chamber (1) by driving the belt conveyers (33) and (18). In this case, a desired magnitude of

vacuum is already established within the chamber (1).

Subsequently, the opening (19) is closed by the valve mechanism (21) while gaseous CCl_4 is being introduced to the interior of the automotive part via the reaction gas inlet tube (10). At the same time, furthermore, the wafer mount platform (17) ascends, and the wafer (8), which has been mounted on the belt conveyer (18), is mounted on the wafer mount platform (17), and subsequently, the belt conveyers (18) and (18) are moved respectively toward the left and right, eventually resulting in their interval surpassing the diameter of the wafer (8). Next, the wafer mount platform (17) descends, and the wafer (8) is mounted on the lower electrode (14). A high-frequency power is impressed between the upper electrode (13) and lower electrode (14) in this state, as a result of which a plasma is generated, and the aluminum film on the wafer (8) surface is etched.

After an approximate half of the treatment in the first-step chamber (1) has been completed, the wafer (8) which has been stored in the second lowermost cassette (5) is imported into the second lowermost chamber (1), and the aluminum film on the wafer (8) surface is etched by using gaseous CCl_4 in this second-step chamber (1).

The aforementioned cassette (5) is temporarily elevated during

this etching operation, whereas the cassette (5') is elevated to a position corresponding to the uppermost chamber (1).

After the etching operation in the first-step chamber (1) has been completed, the wafer (8) is returned to the vacuum preliminary chamber (3) by reversing the order of the aforementioned procedures, and the wafer (8) is mounted onto the belt conveyers (34) by driving the belt conveyers (33) and (34), and the wafer (8) which has undergone the aluminum film etching treatment is stored in the vacant cassette (5') by moving said belt conveyers (34) forward. /4

Next, the belt conveyers (34) are lowered to positions which do not interfere with the ascending and descending actions of the vacant cassettes (5) and (5'). Subsequently, the belt conveyer (34), which has been designated in specific correspondence to the third-step plasma generation chamber (1), is moved forward, whereas the vacant cassette (5') is lowered, and the wafer (34) [sic: Presumably "(8)"], which has undergone the aluminum film etching treatment, is mounted on the third-step belt conveyer (34) according to procedures similar to the aforementioned ones. At this stage, gaseous CF_4 is filled into the third-step plasma generation chamber (1) as a reaction gas, and a plasma cleaning treatment is performed in this chamber (1).

While the cleaning treatment is thus being performed on the wafer (8), which has undergone the aluminum film etching treatment, within the third-step chamber (1), the wafer (8) which has been stored in the third lowermost wafer storage cassette (5) undergoes an aluminum film etching treatment within the uppermost chamber (1).

The wafer (8) which has thus undergone the cleaning treatment within the third-step chamber (1) is returned once again to the vacant cassette (5') according to procedures similar to the aforementioned ones, and subsequently, it is imported into the fourth-step chamber (1) according to procedures similar to the aforementioned ones. A treatment for ashing a resist film by a plasma is performed in this chamber (1) while gaseous O_2 is being introduced as a reaction gas. Concomitantly, the wafer (8) which has undergone the aluminum film etching treatment within the second-step chamber (1) undergoes a cleaning treatment within the third-step chamber (1).

It is thus that multiple wafers continuously undergo plasma treatments under different treatment conditions.

The utility example shown above merely represents an example, and the reaction conditions, etc. can be arbitrarily designated. In the application example, furthermore, a vacuum pump and a high-

frequency power source are configured for each of the individual plasma generation chambers, but a single vacuum pump or high-frequency power source may also be shared by them.

A case where the vacuum preliminary chambers (3) ... are individually and auxiliarily configured on either profile sides of the multiple plasma generation chambers (1), ..., furthermore, has been explained in the example shown in the figures, but in an alternative embodiment, the vacuum preliminary chambers (3) ... may be individually and auxiliarily configured on both profile sides of the multiple plasma generation chambers (1), ... while the wafer (8) which has been imported via one vacuum preliminary chamber (3) is being exported via the other vacuum preliminary chamber (3). In this case, however, the guide components (4) must be erected on the profile sides of both vacuum preliminary chambers.

As the foregoing explanations demonstrate, the present invention provides a constitution wherein plasma generation chambers to which vacuum preliminary chambers are auxiliarily attached are configured in overlapping fashions along the vertical direction within the device mainframe, whereas cassettes in which wafers are being stored are retained on the profile sides of these vacuum preliminary chambers in (un)liftable fashions via guide components, whereas the wafer exchange between the wafer storage

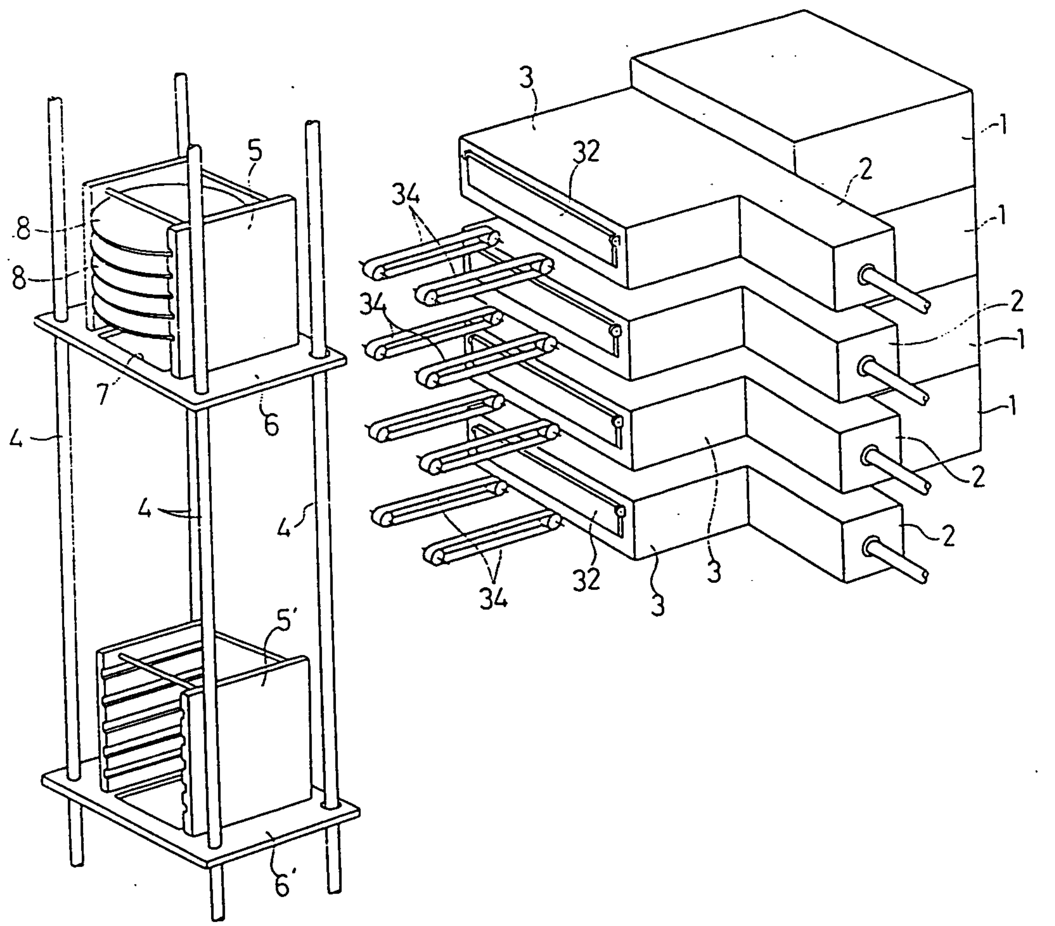
cassette and the interior of the plasma generation chamber is enabled by a transportation mechanism. Since various plasma treatments can be continuously performed on multiple wafers under different conditions within a single device, the productivity is phenomenally improved in comparison with the prior art, and another notable effect lies in the minimal space occupied by the device itself, which is no different from that of the device of the prior art.

4. Brief explanation of the figures

Figure 1 is a diagram which shows an oblique view of the main components of the multi-step plasma treatment device of the present invention. Figure 2 is a diagram which shows a longitudinal cross-sectional view of the main components of the same. Figure 3 is a diagram which shows a lateral cross-sectional view of the main components of the same. Figures 4 and 5 are diagrams which show lateral cross-sectional views of valve mechanism actions.

In the figures, the notations denote the following: (1): Plasma generation chamber; (3): Vacuum preliminary chamber; (4): Guide components; (5) and (5'): Wafer storage cassettes; (8): Wafer; (13) and (14): Electrodes; (18), (33), and (34): Transportation mechanisms; (21): Valve mechanism.

第 1 図



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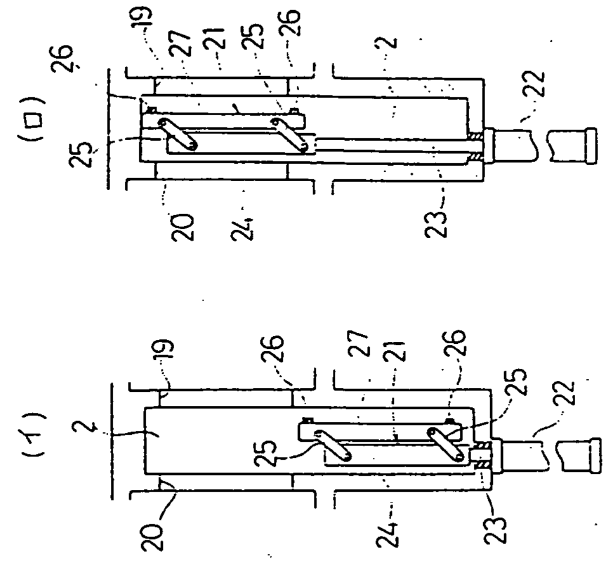
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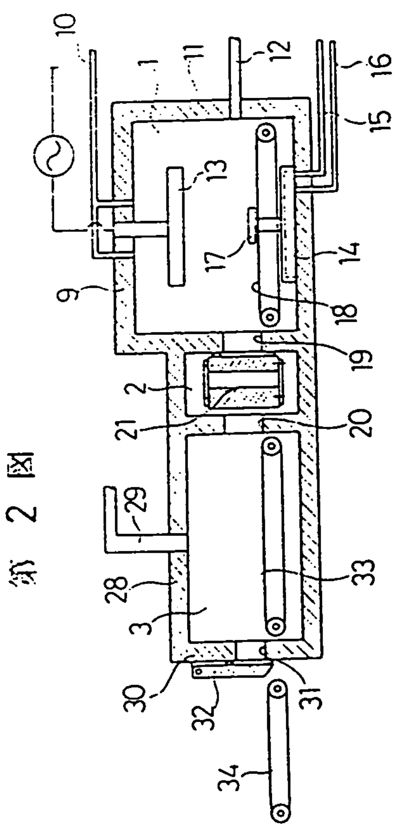
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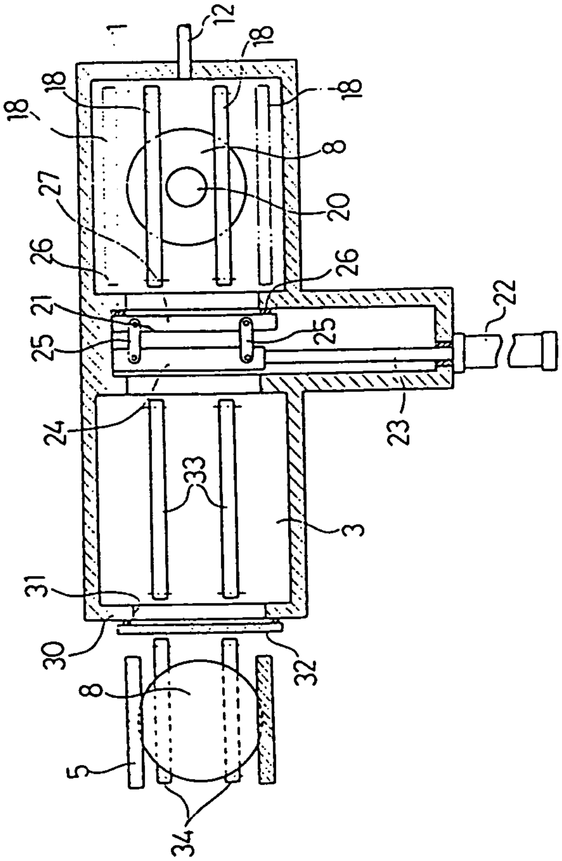
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